

~~Draw~~ AB/BC

Logic 2

Failure in Motion

Form B

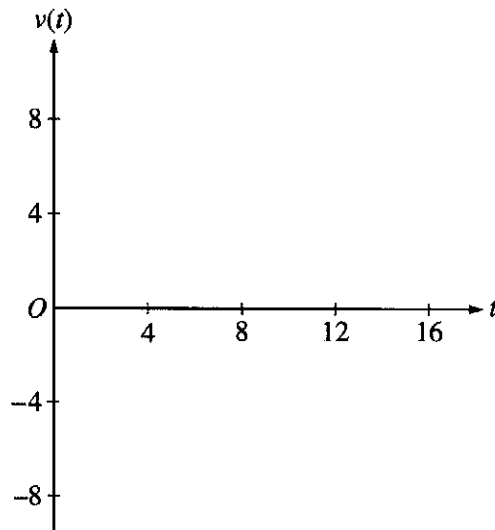
BC only
Form B

2002 AP[®] CALCULUS AB FREE-RESPONSE QUESTIONS (Form B)

3. A particle moves along the x -axis so that its velocity v at any time t , for $0 \leq t \leq 16$, is given by $v(t) = e^{2 \sin t} - 1$. At time $t = 0$, the particle is at the origin.

(a) On the axes provided, sketch the graph of $v(t)$ for $0 \leq t \leq 16$.

(Note: Use the axes provided in the test booklet.)



- (b) During what intervals of time is the particle moving to the left? Give a reason for your answer.
- (c) Find the total distance traveled by the particle from $t = 0$ to $t = 4$.
- (d) Is there any time t , $0 < t \leq 16$, at which the particle returns to the origin? Justify your answer.
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END OF PART A OF SECTION II

2003 AP[®] CALCULUS AB FREE-RESPONSE QUESTIONS (Form B)

CALCULUS AB

SECTION II, Part B

Time—45 minutes

Number of problems—3

No calculator is allowed for these problems.

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4. A particle moves along the x -axis with velocity at time $t \geq 0$ given by $v(t) = -1 + e^{1-t}$.
- (a) Find the acceleration of the particle at time $t = 3$.
 - (b) Is the speed of the particle increasing at time $t = 3$? Give a reason for your answer.
 - (c) Find all values of t at which the particle changes direction. Justify your answer.
 - (d) Find the total distance traveled by the particle over the time interval $0 \leq t \leq 3$.
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2004 AP[®] CALCULUS AB FREE-RESPONSE QUESTIONS (Form B)

t (minutes)	0	5	10	15	20	25	30	35	40
$v(t)$ (miles per minute)	7.0	9.2	9.5	7.0	4.5	2.4	2.4	4.3	7.3

3. A test plane flies in a straight line with positive velocity $v(t)$, in miles per minute at time t minutes, where v is a differentiable function of t . Selected values of $v(t)$ for $0 \leq t \leq 40$ are shown in the table above.
- (a) Use a midpoint Riemann sum with four subintervals of equal length and values from the table to approximate $\int_0^{40} v(t) dt$. Show the computations that lead to your answer. Using correct units, explain the meaning of $\int_0^{40} v(t) dt$ in terms of the plane's flight.
- (b) Based on the values in the table, what is the smallest number of instances at which the acceleration of the plane could equal zero on the open interval $0 < t < 40$? Justify your answer.
- (c) The function f , defined by $f(t) = 6 + \cos\left(\frac{t}{10}\right) + 3 \sin\left(\frac{7t}{40}\right)$, is used to model the velocity of the plane, in miles per minute, for $0 \leq t \leq 40$. According to this model, what is the acceleration of the plane at $t = 23$? Indicate units of measure.
- (d) According to the model f , given in part (c), what is the average velocity of the plane, in miles per minute, over the time interval $0 \leq t \leq 40$?

END OF PART A OF SECTION II

2005 AP[®] CALCULUS AB FREE-RESPONSE QUESTIONS (Form B)

3. A particle moves along the x -axis so that its velocity v at time t , for $0 \leq t \leq 5$, is given by $v(t) = \ln(t^2 - 3t + 3)$. The particle is at position $x = 8$ at time $t = 0$.
- (a) Find the acceleration of the particle at time $t = 4$.
 - (b) Find all times t in the open interval $0 < t < 5$ at which the particle changes direction. During which time intervals, for $0 \leq t \leq 5$, does the particle travel to the left?
 - (c) Find the position of the particle at time $t = 2$.
 - (d) Find the average speed of the particle over the interval $0 \leq t \leq 2$.
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WRITE ALL WORK IN THE TEST BOOKLET.

END OF PART A OF SECTION II

2006 AP[®] CALCULUS AB FREE-RESPONSE QUESTIONS (Form B)

t (sec)	0	15	25	30	35	50	60
$v(t)$ (ft/sec)	-20	-30	-20	-14	-10	0	10
$a(t)$ (ft/sec ²)	1	5	2	1	2	4	2

6. A car travels on a straight track. During the time interval $0 \leq t \leq 60$ seconds, the car's velocity v , measured in feet per second, and acceleration a , measured in feet per second per second, are continuous functions. The table above shows selected values of these functions.

- (a) Using appropriate units, explain the meaning of $\int_{30}^{60} |v(t)| dt$ in terms of the car's motion. Approximate

$\int_{30}^{60} |v(t)| dt$ using a trapezoidal approximation with the three subintervals determined by the table.

- (b) Using appropriate units, explain the meaning of $\int_0^{30} a(t) dt$ in terms of the car's motion. Find the exact

value of $\int_0^{30} a(t) dt$.

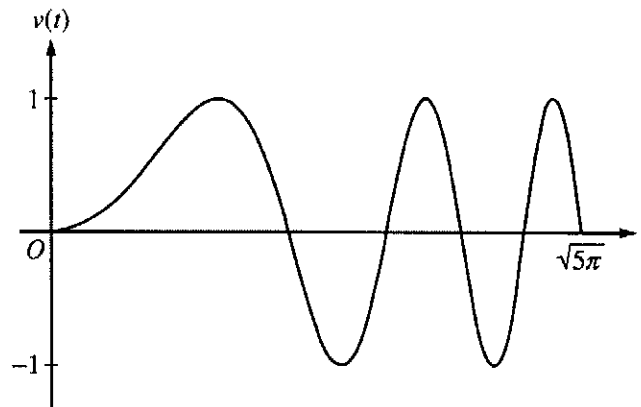
- (c) For $0 < t < 60$, must there be a time t when $v(t) = -5$? Justify your answer.

- (d) For $0 < t < 60$, must there be a time t when $a(t) = 0$? Justify your answer.

WRITE ALL WORK IN THE EXAM BOOKLET.

END OF EXAM

2007 AP[®] CALCULUS AB FREE-RESPONSE QUESTIONS (Form B)



2. A particle moves along the x -axis so that its velocity v at time $t \geq 0$ is given by $v(t) = \sin(t^2)$. The graph of v is shown above for $0 \leq t \leq \sqrt{5\pi}$. The position of the particle at time t is $x(t)$ and its position at time $t = 0$ is $x(0) = 5$.
- (a) Find the acceleration of the particle at time $t = 3$.
 - (b) Find the total distance traveled by the particle from time $t = 0$ to $t = 3$.
 - (c) Find the position of the particle at time $t = 3$.
 - (d) For $0 \leq t \leq \sqrt{5\pi}$, find the time t at which the particle is farthest to the right. Explain your answer.
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WRITE ALL WORK IN THE EXAM BOOKLET.

2008 AP[®] CALCULUS AB FREE-RESPONSE QUESTIONS (Form B)

2. For time $t \geq 0$ hours, let $r(t) = 120(1 - e^{-10t^2})$ represent the speed, in kilometers per hour, at which a car travels along a straight road. The number of liters of gasoline used by the car to travel x kilometers is modeled by $g(x) = 0.05x(1 - e^{-x/2})$.
- (a) How many kilometers does the car travel during the first 2 hours?
 - (b) Find the rate of change with respect to time of the number of liters of gasoline used by the car when $t = 2$ hours. Indicate units of measure.
 - (c) How many liters of gasoline have been used by the car when it reaches a speed of 80 kilometers per hour?
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WRITE ALL WORK IN THE EXAM BOOKLET.

2009 AP[®] CALCULUS AB FREE-RESPONSE QUESTIONS (Form B)

t (seconds)	0	8	20	25	32	40
$v(t)$ (meters per second)	3	5	-10	-8	-4	7

6. The velocity of a particle moving along the x -axis is modeled by a differentiable function v , where the position x is measured in meters, and time t is measured in seconds. Selected values of $v(t)$ are given in the table above. The particle is at position $x = 7$ meters when $t = 0$ seconds.
- (a) Estimate the acceleration of the particle at $t = 36$ seconds. Show the computations that lead to your answer. Indicate units of measure.
- (b) Using correct units, explain the meaning of $\int_{20}^{40} v(t) \, dt$ in the context of this problem. Use a trapezoidal sum with the three subintervals indicated by the data in the table to approximate $\int_{20}^{40} v(t) \, dt$.
- (c) For $0 \leq t \leq 40$, must the particle change direction in any of the subintervals indicated by the data in the table? If so, identify the subintervals and explain your reasoning. If not, explain why not.
- (d) Suppose that the acceleration of the particle is positive for $0 < t < 8$ seconds. Explain why the position of the particle at $t = 8$ seconds must be greater than $x = 30$ meters.

WRITE ALL WORK IN THE EXAM BOOKLET.

END OF EXAM